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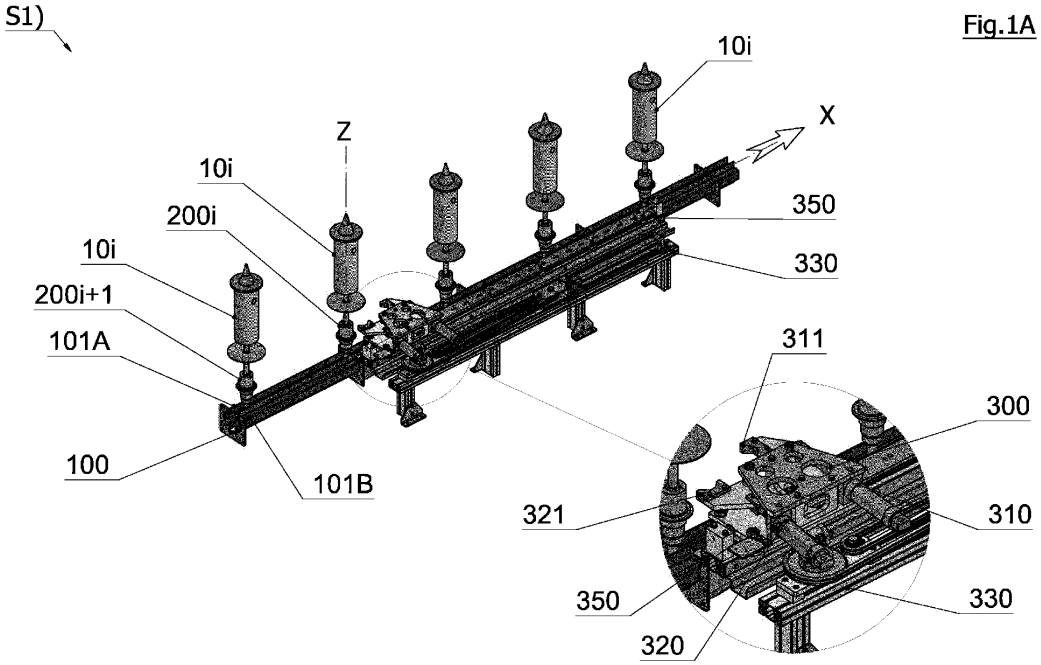
(54) SYSTEM FOR THE SURFACE TREATMENT OF SEMI-FINISHED WORKPIECES

(57) A system for the surface treatment of semi-finished workpieces, comprising a sequence of work stations (Si), a linear horizontal belt or chain conveyor (100) having a continuous direction of movement (X) along longitudinal sliding guides (101A, 101B), a series of vertical spindles (200i) for supporting said semi-finished workpieces (10i), wherein the vertical spindles (200i) are mounted in longitudinal succession on the linear conveyor (100) configured and disposed for the conveyance of the semi-finished workpieces (10i) through the sequence of work stations (Si), wherein at least one work station (S1) has a releasable clamping means (300) of the vertical spindles (200i), wherein said releasable clamping means (300) is configured and disposed so as to block the oscillations and/or rotations of the vertical spindles (200i) with respect to the direction of movement (X) of the linear conveyor (100) during the transit of the vertical spindles (200i) through the work station (S1).

Fig.1A



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Description

[0001] The present invention relates to a system for the surface treatment of semi-finished workpieces, of the type comprising a sequence of work stations to which the workpieces are fed by means of a horizontal belt or chain conveyor on which a series of vertical workpiece support spindles are mounted.

[0002] It is known that since robotic manipulators have been used to process the workpieces passing through the subsequent work stations, the correct execution of the processing can depend on the identification of the exact position of the workpieces.

[0003] In fact, the work stations often include robotic manipulators that are programmed for the intervention on the workpieces based on a prediction of their position.

[0004] One of the main drawbacks of conveyors with vertical support spindles is related to the possible oscillation of the spindles with respect to the conveyor advancement direction or the rotation of the spindles on their axis during the advancement.

[0005] An emblematic case is related to vehicle wheel rim coating systems, where the spindles support the vehicle wheel rims that must be coated and in which selective zones where the coating must not be applied must be protected before the coating.

[0006] As known, an external channel in the wheel rim onto which the tyre is mounted, a central hub and a plurality of radial spokes or a continuous element connecting the central hub to the external channel can be found.

[0007] Before coating, the holes for the passage of the fixing bolts for fixing the wheel rim to the vehicle positioned at the central hub as well as other predefined zones of the rim are protected with appropriate masks to avoid the coating thereof; the wheel rims are thus coated and then transferred to another spindle conveyor for the polymerisation process inside a furnace, after which the masks are removed.

[0008] Traditionally, an optical head at the entry to the mask application station recognises the rim and its positioning, and transmits the necessary coordinates for programming to a subsequent manipulator for the application of the masks.

[0009] The vertical spindles supporting the rims, or other semi-finished products to be treated in the coating cycle, typically have a conical head provided with a lower flange that engages the central hub of the rim, and a base for fixing to the horizontal conveyor.

[0010] Although the conveyor is constrained by longitudinal sliding guides, the spindles burdened by the weight of the rim can undergo small oscillations with respect to the advancement direction of the conveyor and the rotations around its axis, especially when the high productivity required by the system involves high conveyor speeds.

[0011] Due to these positional variations, the manipulator of the coating masks acting based on the positioning detected by the optical head can consequently position the masks in the respective housing no longer coinciding with the detected position, and therefore in an inaccurate or forced manner.

[0012] At the end of the treatment cycle, this can result in a significant increase in production waste.

[0013] A further drawback related to the oscillation of the spindles can similarly occur in the unloading station from the conveyor of the workpieces sprayed with coating but still to be sent to the firing furnace and/or the finished workpieces.

[0014] In fact, due to the oscillation of the spindles, during the extraction of the semi-finished products from the spindles, the manipulator can no longer find the workpiece exactly in the position detected by the optical head and expected, and can cause smears and/or indentations in the coating which has not yet stabilised on the finished coating if the coated workpiece has already undergone the passage in the furnace.

[0015] Also in this case, the obvious consequence is a substantial increase in production waste.

[0016] The technical task of the present invention is therefore to provide a system for the surface treatment of semi-finished workpieces of the type described above that makes it possible to eliminate the cited technical drawbacks of the prior art.

[0017] Within the context of this technical task an object of the invention is to provide a system for the surface treatment of semi-finished workpieces with high productivity and efficiency.

[0018] Another object of the invention is to provide a system for the surface treatment of semi-finished workpieces with a reduced incidence of production waste.

[0019] Last but not least, an object of the invention is to provide a system for the surface treatment of semi-finished workpieces, typically a system for coating wheel rims for vehicles with improved performance in terms of efficiency, precision and quality of the finished product.

[0020] The technical task, as well as these and other objects, according to the present invention are achieved by providing a system for the surface treatment of semi-finished workpieces, comprising a sequence of work stations, a linear horizontal belt or chain conveyor having a continuous direction of movement along longitudinal sliding guides, a series of vertical spindles for supporting said semi-finished workpieces, said spindles being mounted in longitudinal succession on said conveyor, said conveyor being configured and disposed for the conveyance of said semi-finished workpieces through said sequence of work stations, characterised in that at least one work station of said sequence of work stations has a releasable clamping means for clamping said spindles, said clamping means being configured and disposed to block the oscillations and rotations of said spindles with respect to said direction of movement of said conveyor during the transit of said spindles through said at least one work station.

[0021] In a preferred embodiment, said clamping means comprises at least one arm with a gripping termi-

nal that can be actuated between a position of interference with said spindles and a position of non-interference with said spindles.

[0022] In a preferred embodiment, said gripping terminal has a profile complementarily shaped with respect to the zones of interference and engagement with said spindles.

[0023] In a preferred embodiment said arms in said position of interference are movable along the trajectory followed by said spindles in the movement of the conveyor between a position of entry and a position of exit from said at least one work station.

[0024] In a preferred embodiment said arms in said position of interference are passively drawn by said spindles.

[0025] In a preferred embodiment, said arms in said position of interference are drawn by said spindles towards said exit position in opposition to an elastic element of return towards said entry position.

[0026] In a preferred embodiment said workpieces are wheel rims for vehicles.

[0027] In a preferred embodiment, said plurality of stations comprises at least one station for loading said semi-finished workpieces to be coated onto said linear conveyor, at least one station for masking parts of said semi-finished workpieces that are not to be coated, at least one station for coating of the semi-finished workpieces, and at least one station for unloading said coated semi-finished workpieces from said linear conveyor.

[0028] In a preferred embodiment said at least one work station of said sequence of work stations having a releasable clamping means of said spindles is a masking station.

[0029] In a preferred embodiment said at least one work station of said sequence of work stations having a releasable clamping means of said spindles is an unloading station.

[0030] In a preferred embodiment said semi-finished workpieces are wheel rims for vehicles.

[0031] Further features and advantages of the invention will become more apparent from the description of a preferred, but not exclusive, embodiment of a system for the surface treatment of semi-finished workpieces according to the invention, illustrated by way of indicative and non-limiting example in the accompanying drawings, in which:

figures 1A, 2A, 3A, 4A, 5A, 6A, 7A show a sequence of perspective views of a work station of a system for the surface treatment of semi-finished workpieces according to the invention;

figures 1B, 2B, 3B, 4B, 5B, 6B, 7B show a corresponding sequence of plan views of a work station of a system for the surface treatment of semi-finished workpieces according to the invention;

[0032] A system for the surface treatment of semi-finished workpieces comprises a plurality of successive work stations in which different processes are carried out in sequence.

[0033] Typically, such a surface treatment system comprises at least one station for loading the semi-finished workpieces to be coated on a conveyor of a known type, at least one station for masking parts of the semi-finished workpieces that are not to be coated, at least one station for coating the semi-finished workpieces of a known type, and at least one station for unloading the coated workpieces from the conveyor.

[0034] With reference to the aforementioned figures, a work station is shown, indicated overall with the reference number S1, in the case illustrated, typically but not exclusively, a station for masking parts of the semi-finished workpieces not to be coated.

[0035] A linear horizontal belt or chain conveyor 100 has a continuous direction X of movement along longitudinal sliding guides 101A and 101B for the sliding of a series of vertical spindles 200i mounted in longitudinal succession at constant pitch p on the linear conveyor 100 itself, it is configured and disposed for the transport of semi-finished workpieces 10i through a sequence of work stations.

[0036] Typically, the semi-finished workpieces 10i treated by the surface treatment system are wheel rims for vehicles: for illustrative and graphic simplicity, the aforementioned figures represent the simplest spindles.

[0037] The semi-finished workpieces 10i can be any, as long as they can be engaged with vertical axis spindles.

[0038] The vertical spindles 200i for supporting the semi-finished workpieces 10i to be treated in the surface treatment cycle typically have a conical head 211 provided with a lower flange 212 that axially engages the semi-finished workpiece 10i, and a fixing base 213 suitably constrained to the linear horizontal conveyor 100.

[0039] The semi-finished workpieces 10i typically have at least one intervention point 20, typically a plurality of intervention points 20i, on which automated manipulators of the known type must intervene.

[0040] In a station for masking S1 parts of the semi-finished workpieces not to be coated like that shown, such an intervention point 20, or such a plurality of intervention points 20i are points that must be protected from the coating operations.

[0041] Suitably, the work station S1 has a releasable clamping means 300 for clamping the vertical spindles 200i, suitably configured and disposed so as to block any oscillations and/or rotations of such spindles 200i relative to or transversely to the direction X, and also combined, during the transit through the station S1.

[0042] The releasable clamping means 300 is typically configured laterally to the linear conveyor 100, and is movable along its own guide 350 typically in parallel along the trajectory followed by the spindles 200i between a position of entry 110 and a position of exit 120 from the work station S1.

[0043] The releasable clamping means 300 comprises

at least one arm 310 with a gripping terminal 311, respectively, preferably two arms 310 and 320 with respective gripping terminals 311 and 321. Such arms 310 and 320 and gripping terminals 311 and 321 can be actuated by a movement means of a known type between a position of interference and a position of non-interference with the vertical spindles 200i.

[0044] Suitably, the gripping terminals 311 and 321 have a profile respectively complementary in shape with respect to the zones of interference and engagement of the spindle 200i.

[0045] Advantageously, the releasable clamping means 300 with the arms 310 and 320 in the position of interference is passively dragged along its own guide 350 by the vertical spindles 200i in the movement of the conveyor 100 along the direction X from the position of entry 110 to the position of exit 120 from the work station S1.

[0046] Advantageously, the releasable clamping means 300 is drawn towards the exit position 120 in opposition to an element of return 330 towards the entry position 110.

[0047] The operation of the system for the treatment of semi-finished workpieces according to the invention appears clear from the description and illustration and, in particular, is substantially as follows.

[0048] In a loading station of the surface treatment system, loading means and manipulators of the known type load the semi-finished workpieces 10i to be treated on the vertical spindles 200i where they are axially engaged by the conical head 211 and supported by the flange 212.

[0049] The vertical spindle 200i supporting the semi-finished workpiece 10i is drawn by the linear conveyor 100 to which it is constrained through the fixing base 213 in the direction of movement X towards the station S1; in the preferred but not exclusive embodiment illustrated, the station S1 is a station for masking parts of the semi-finished workpieces that are not to be coated.

[0050] At the position of entry 110 in the station S1, the releasable clamping means 300 is activated with detection and actuation means of known type: at least a first arm 310 with respective gripping terminal 311 is activated.

[0051] When advancing in the direction of movement X the spindle 200i is therefore engaged with the gripping terminal 311 which has a profile complementary in shape with respect to the zones of interference and engagement of the spindle 200i, blocking it on the vertical axis Z and preventing any oscillations.

[0052] In the event of semi-finished workpieces 10i of particular weight and/or size, a second arm 320 with respective gripping terminal 312 is also activated, typically in opposition to the gripping terminal 311 on the spindle 200i.

[0053] Figure 1A and 1B shows the spindle 200i in the entry position 110 of the station S1.

[0054] The stroke c of the first releasable clamping means 300 along its guide 350 is depicted at the beginning with c0.

[0055] The releasable clamping means 300 with the arm 310 in the position of interference is then passively drawn by the vertical spindles 200i along the guide 350 in the movement of the conveyor 100 along the direction X.

[0056] Figure 2A and 2B shows the spindle 200i engaged by the gripping terminal 311 at a first specific work station 400 within the station S1: an optical reader of the known type frames the semi-finished workpiece 10i, detects the position in the space of the intervention point 20, or of the plurality of intervention points 20i, and transfers the information of the coordinates and of the reference system to a subsequent second specific work station 500.

[0057] Continuing in the movement of the conveyor 100 along the direction X, the spindle 200i reaches the second specific work station 500 in position 115: the stroke c of the releasable clamping means 300 along its guide 350 is depicted in the figure with c1.

[0058] The engagement of the releasable clamping means 300 with the spindle 200i ensures its stability along the Z axis and therefore the semi-finished workpiece 10i appear in the second work station 500 with the intervention point 20 or with the plurality of intervention points 20i as detected in the space and transferred from the optical reader of the first specific work station 400.

[0059] The second specific work station 500 inside the illustrated station S1 comprises a manipulator of the known type which, thus instructed, provides for the positioning of the coating masks 510i at the intervention points 20i as detected and transferred by the optical reader of the first specific work station 400.

[0060] Figure 3A and 3B show the spindle 200i engaged by the gripping terminal 311 at the second specific work station 500.

[0061] Continuing in the movement of the conveyor 100 along the direction X, the spindle 200i reaches the position of exit 120 from the station S1; the stroke c of the releasable clamping means 300 along its guide 350 is depicted by c2, where typically c2 is equal to two times c1.

[0062] At the exit position 120, suitable known means activate the release of the releasable clamping means 300, and the first arm 310 with respective gripping terminal 311 are positioned in a position of non-interference with the vertical spindle 200i.

[0063] Therefore, the vertical spindle 200i is free to continue in the movement of the conveyor 100 along the direction X towards subsequent work stations, where the semi-finished workpiece 10i appear with the coating masks 501i at the intervention points 20i.

[0064] The releasable clamping means 300 no longer interfering with the vertical spindle 200i is then drawn by an element of return 330 towards the entry position 110 in the opposite direction to the direction X of movement of the conveyor 100.

[0065] Advantageously, in a preferred embodiment of the present invention, the return means 330 comprises

a flexible constraint element 331, one or more return pulleys 332, a piston 333 of a pneumatically operated cylinder 334.

[0066] The flexible constraint element 331 is fixed at one end thereof to the clamping means 300, follows a sinuous path guided by one or more return pulleys 332, and is fixed at the distal end opposite the piston 333 of the pneumatically operated cylinder 334.

[0067] In the path of the clamping means 300 from the entry position 110 to the exit position 120, the flexible constraint element 331, drawn by the clamping means, draws the piston 333 of the pneumatically operated cylinder 334 in elongation: in the exit position 120 the piston 333 is at its maximum elongation stroke.

[0068] At the same time as activating a known suitable means for releasing the releasable clamping means 300, a known suitable means for feeding the pneumatically operated cylinder 334 is activated which recalls the piston 333 inside the cylinder 334 towards its minimum elongation position.

[0069] In its stroke from the maximum stroke position to the minimum elongation position, the end of the piston 333 draws the flexible constraint element 331 constrained to the clamping means 300 in the direction opposite the drawing from the entry position 110 to the exit position 120, returning the clamping means 300 to the entry position 110.

[0070] Typically, the clamping means 300 is thus repositioned in the entry position 110 at the vertical spindle 200i+2 of the series of vertical spindles on the even-numbered index conveyor 100; the vertical spindles on the odd-numbered index conveyor 100 are treated on a station S1bis with features identical to the station S1, placed sequentially along the path in direction X of the conveyor 100.

[0071] Figure 4A and 4B show the spindle 200i at the exit position 120 engaged by the gripping terminal 311: the releasable clamping means 300 is engaged with the vertical spindle 200i.

[0072] Figure 5A and 5B show the spindle 200i at the exit position 120 disengaged from the gripping terminal 311: the releasable clamping means 300 is disengaged from the vertical spindle 200i.

[0073] Figure 6A and 6B show the releasable clamping means 300 disengaged from the vertical spindles 200i in the return stroke from the exit position 120 to the entry position 110.

[0074] Figure 7A and 7B show the releasable clamping means 300 upon return to the entry position 110: correspondingly, the passage of the spindle 200i+2 in the entry position 110 activates the detection and actuation means of the known type of the releasable clamping means 300, and the cycle is repeated.

[0075] Advantageously, the features and functionality of the station S1 as innovatively described above for a station for masking parts of the semi-finished workpieces not to be coated can be replicated in a station for unloading the coated workpieces from the conveyor 100, where an optical reader of the known type of a first specific work station 400 frames the semi-finished workpiece 10i, detects the position in the space of the plurality of the intervention points 20i, in the specific case the lifting points, and transfers the information to the next second specific work station 500, where a manipulator of the known type thus instructed provides for hooking the semi-finished workpiece 10i at the intervention points 20i as detected and transferred by the optical reader of the first specific work station 400, ensuring the precise grip thereof and safeguarding the surface finish of the coated semi-finished workpiece.

[0076] In practice, it has been found that a system for the surface treatment of semi-finished workpieces according to the invention is particularly advantageous for the high productivity and reduced incidence of production waste.

[0077] A further advantage of the invention is to create a system for the surface treatment of semi-finished workpieces, typically a system for coating wheel rims for vehicles with improved performance in terms of efficiency, precision and quality of the finished product.

[0078] The system for the treatment of semi-finished workpieces thus conceived is susceptible to numerous modifications and variants, all of which falling within the scope of the inventive concept. Moreover, all details may be replaced with other technically equivalent elements.

[0079] In practice, the materials used, as well as the dimensions, can be any according to the needs and the state of the art.

Claims

1. A system for the surface treatment of semi-finished workpieces, comprising a sequence of work stations (Si), a linear horizontal belt or chain conveyor (100) having a continuous direction of movement (X) along longitudinal sliding guides (101A, 101B), a series of vertical spindles (200i) for supporting said semi-finished workpieces (10i), said vertical spindles (200i) being mounted in longitudinal succession on said linear conveyor (100), said linear conveyor (100) being configured and disposed for the conveyance of said semi-finished workpieces (10i) through said sequence of work stations (Si), **characterised in that** at least one work station (S1) has a releasable clamping means (300) for clamping said vertical spindles (200i), said releasable clamping means (300) being configured and disposed so as to block the oscillations and/or rotations of said vertical spindles (200i) relative to said direction of movement (X) of said linear conveyor (100) during the transit of said vertical spindles (200i) through said at least one work station (S1).

2. The treatment system according to claim 1, **characterised in that** said releasable clamping means

(300) comprises at least one arm (310) with at least one gripping terminal (311) that can be actuated between a position of interference with said vertical spindles (200i) and a position of non-interference with said vertical spindles (200i).

3. The treatment system according to the preceding claim, **characterised in that** said at least one gripping terminal (311) has a profile complementarily shaped with respect to the zones of interference and engagement with said vertical spindles (200i).

4. The treatment system according to either of claims 2 and 3, **characterised in that** said releasable clamping means (300) with said at least one arm (310) with said at least one gripping terminal (311) in said position of interference is movable along the trajectory followed by said vertical spindles (200i) in the movement of the conveyor 100 along the direction (X) between a position of entry (110) into and a position of exit (120) from said at least one work station (S1).

5. The treatment system according to the preceding claim, **characterised in that** said releasable clamping means (300) with said at least one arm (310) with said at least one gripping terminal (311) in said position of interference is passively drawn by said vertical spindles (200i).

6. The treatment system according to the preceding claim, **characterised in that** said releasable clamping means (300) with said at least one arm (310) with said at least one gripping terminal (311) in said position of interference is passively drawn by said vertical spindles (200i) towards said exit position (120) in opposition to an element of return (330) towards said entry position (110).

7. The treatment system according to one or more of the preceding claims, **characterised in that** said treatment system comprises at least one station for loading said semi-finished workpieces (10i) to be coated onto said linear conveyor (100), at least one station for masking parts of said semi-finished workpieces (10i) that are not to be coated, at least one station for coating of the semi-finished workpieces, and at least one station for unloading said coated semi-finished workpieces (10i) from said linear conveyor (100).

8. The treatment system according to one or more of the preceding claims, **characterised in that** said at least one work station (S1) is a masking station for masking at least one point of intervention (20) or a plurality of points of intervention of said semi-finished workpieces (10i) (20i) that are not to be coated.

9. The treatment system according to one or more of the preceding claims 1 to 7, **characterised in that** said at least one work station (S1) is a station for unloading said coated semi-finished workpieces (10i) from said linear conveyor (100).

10. The treatment system according to any of the preceding claims, **characterised in that** said semi-finished workpieces (10i) are wheel rims for vehicles.

Fig.1A

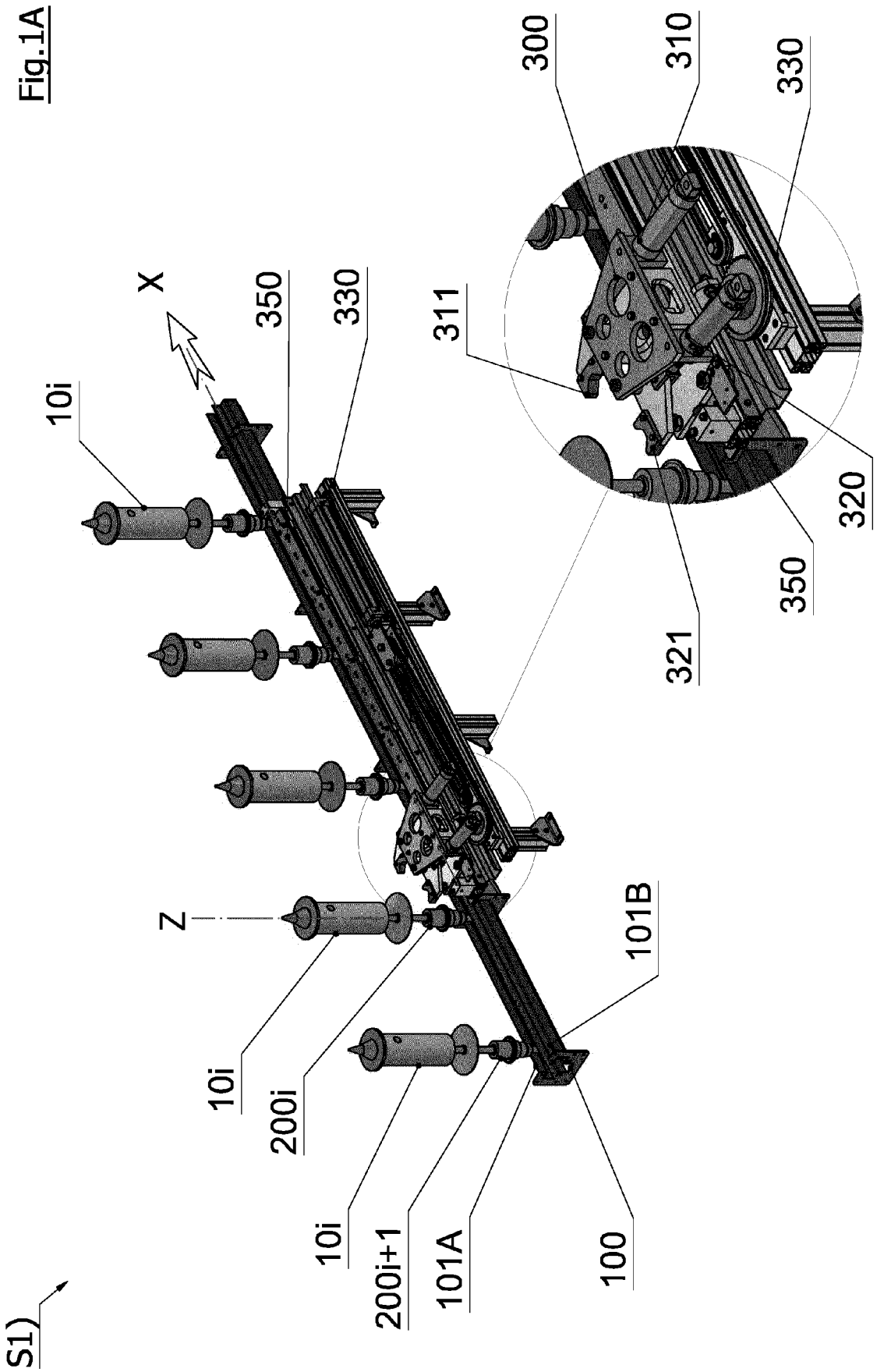

S1)
Z
X
10i
10i
10i
200i
200i+1
101A
101B
100
350
330
311
300
310
330
320
350
321

Fig.2A

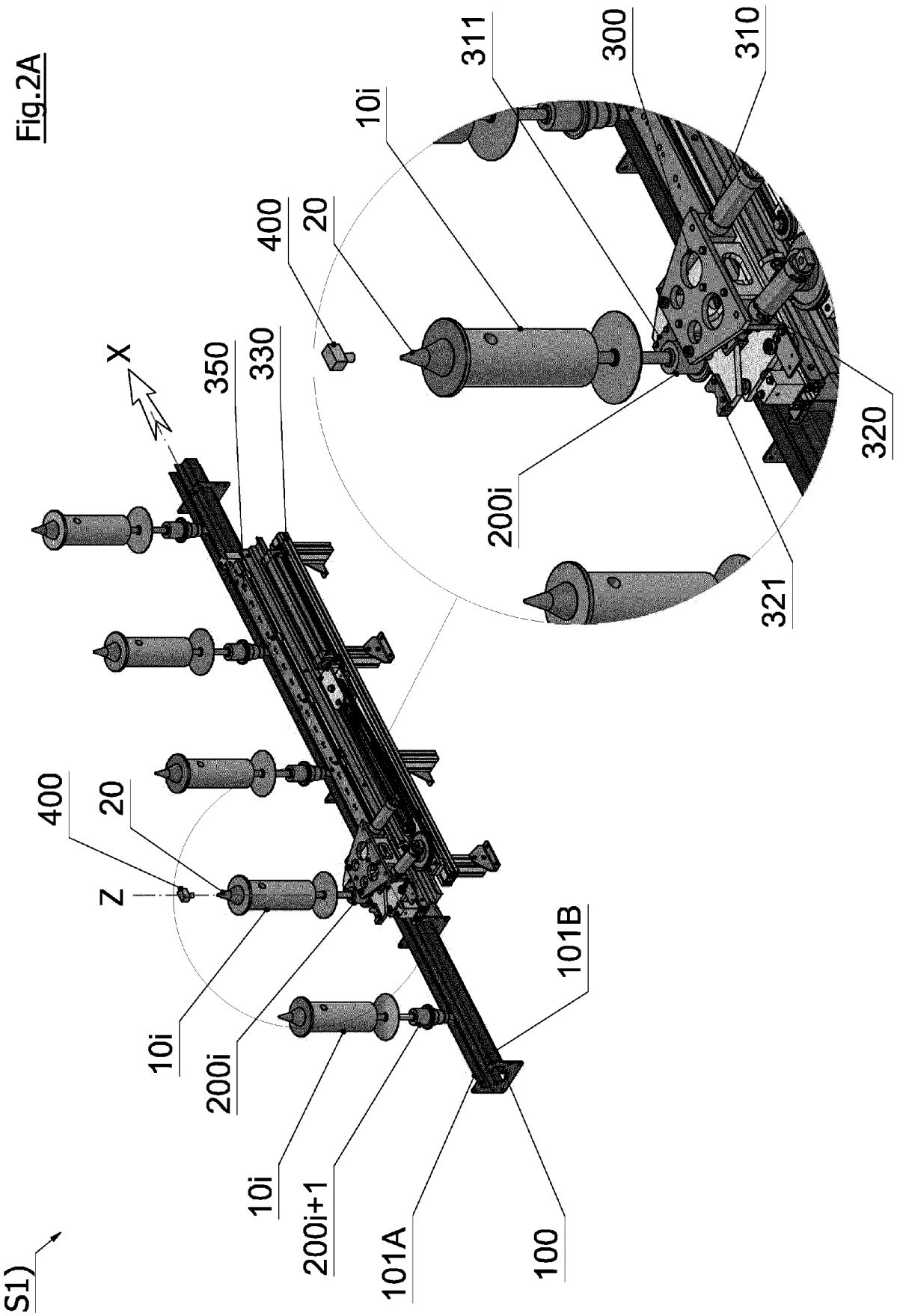

S1)
Z
X
400
20
10i
200i
10i
200i+1
101A
100
101B
350
330
400
20
10i
311
300
310
200i
321
320

Fig.3A

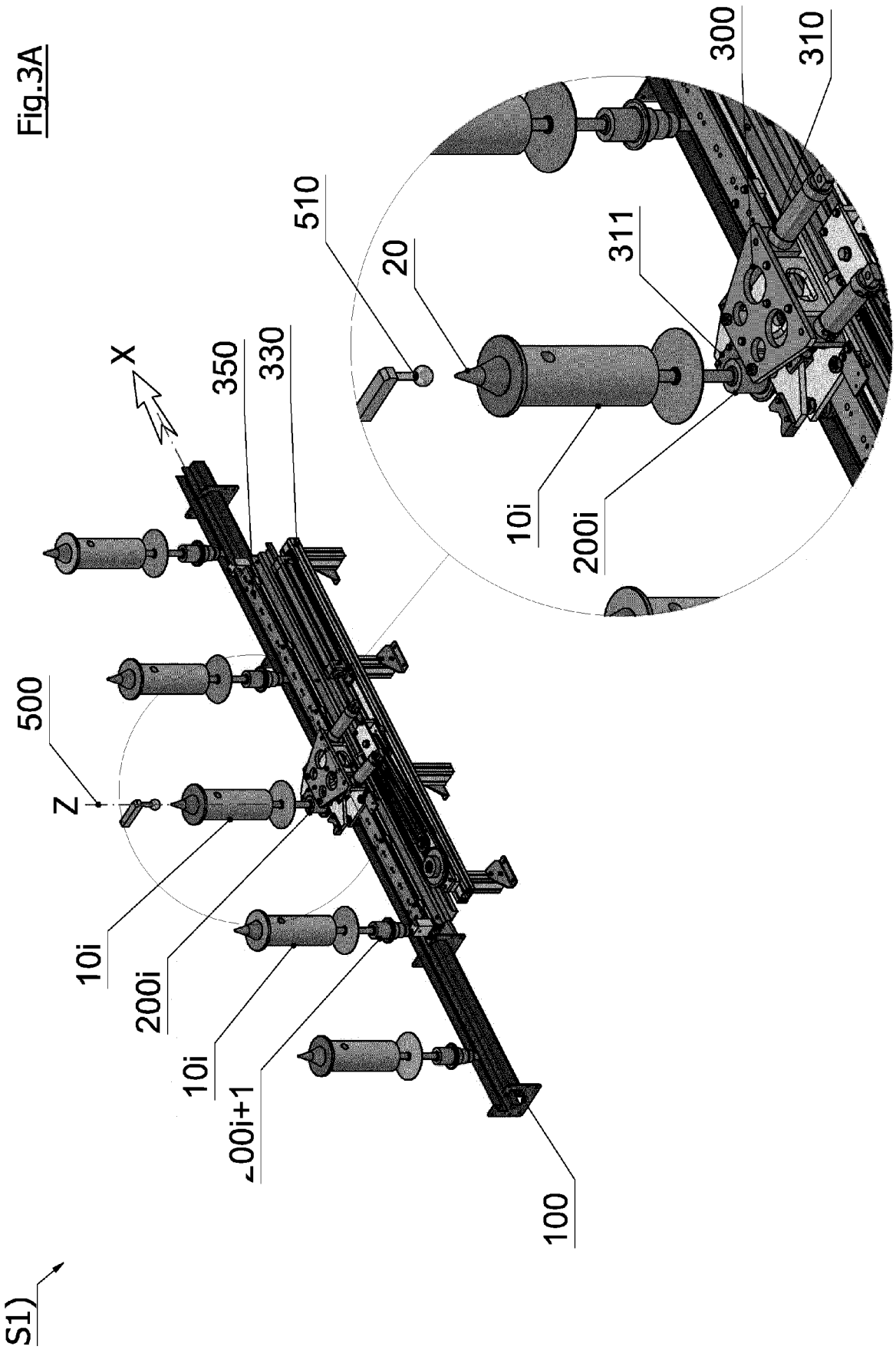

S1)
100
200i+1
10i
200i
10i
Z
500
X
350
330
510
20
311
300
310
10i
200i

Fig.4A

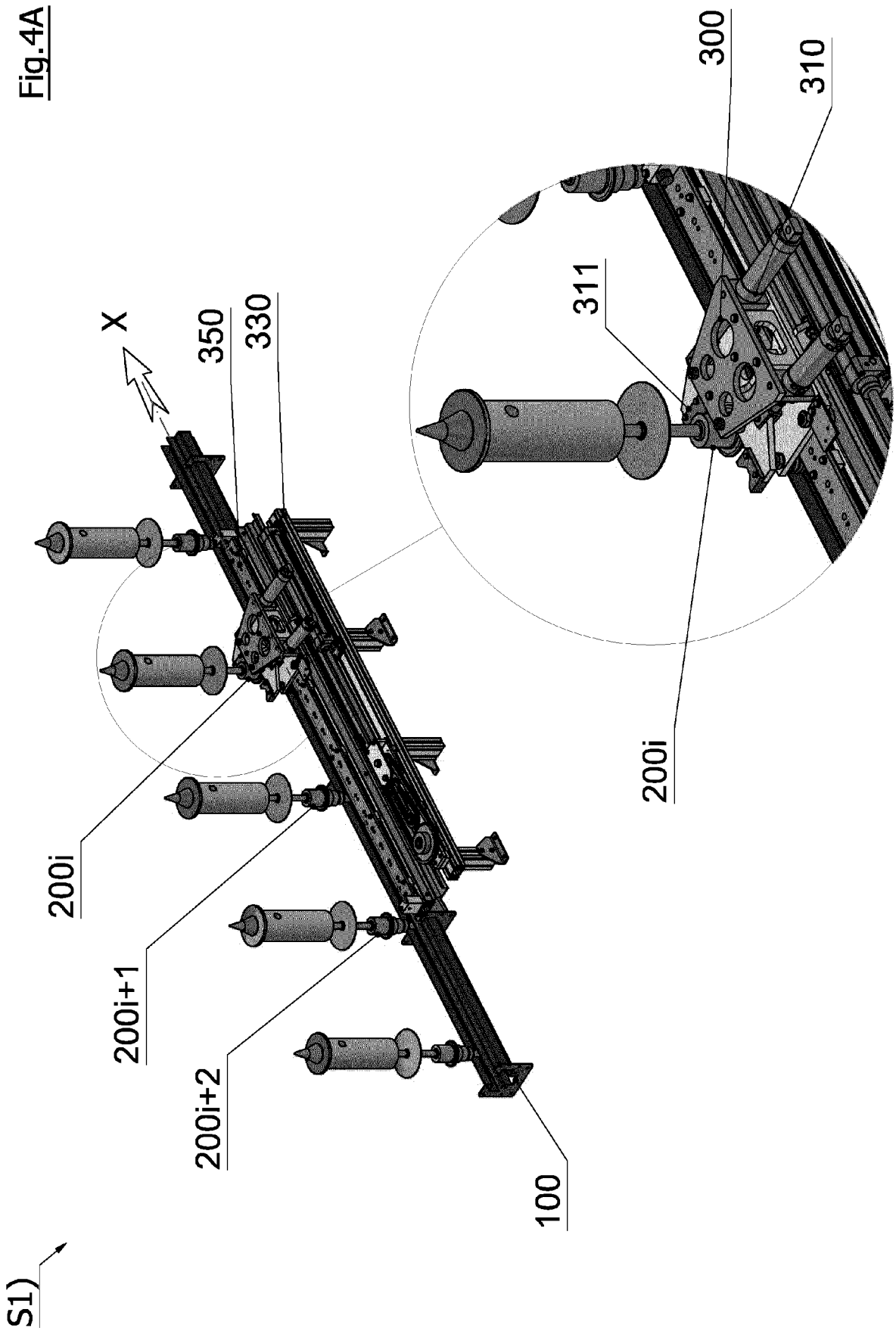


Fig.5A

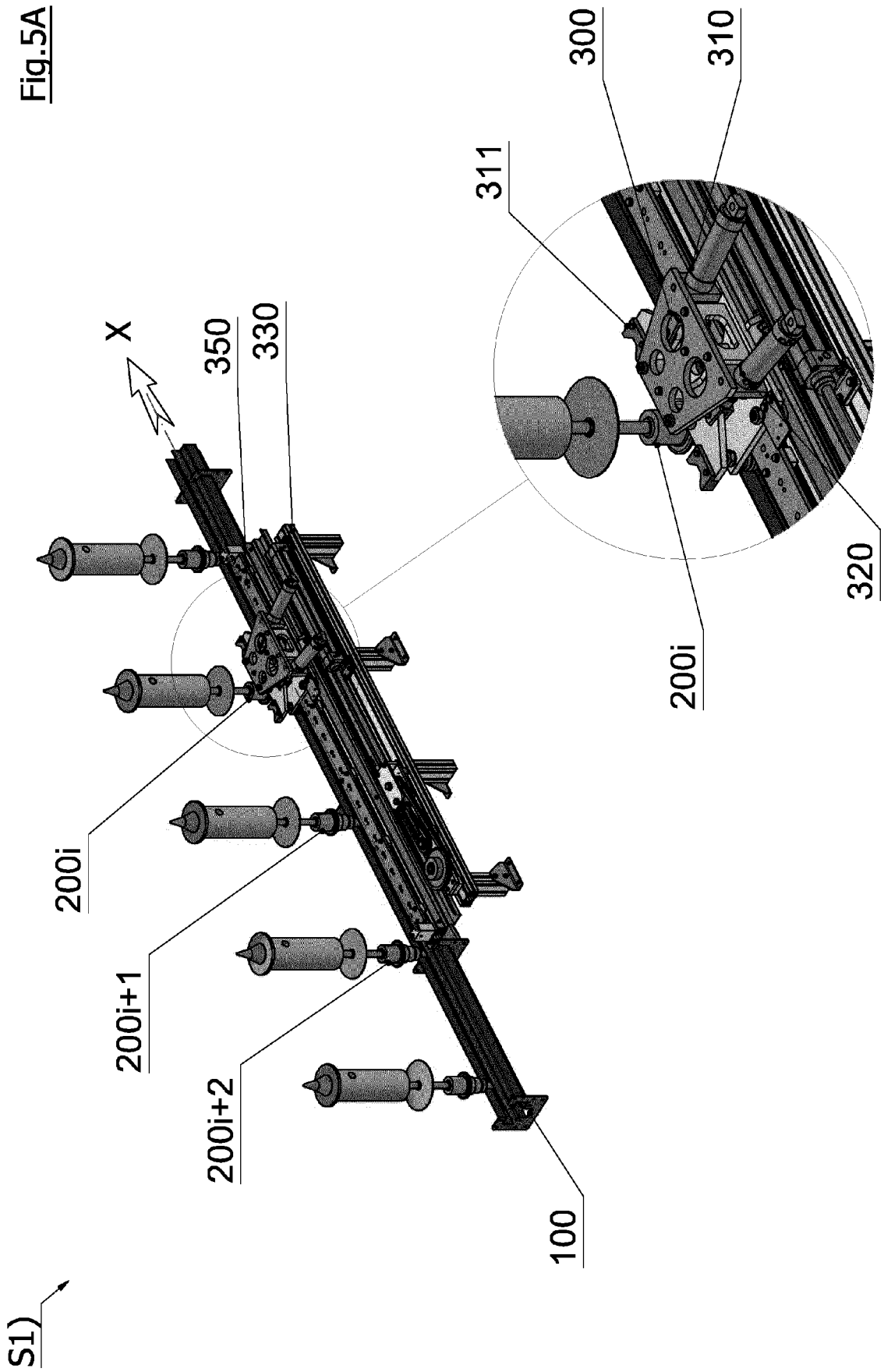


Fig.6A

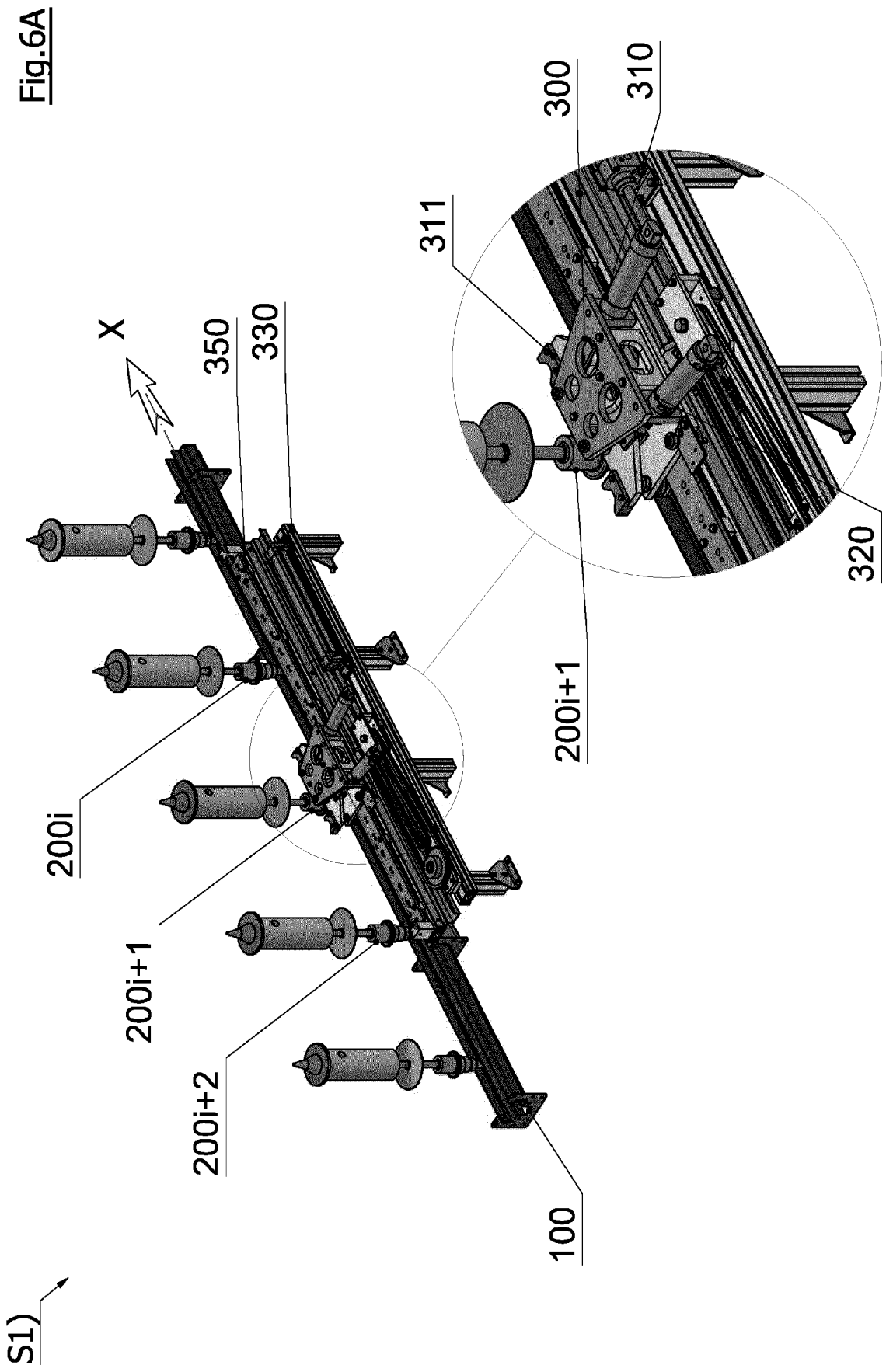


Fig.7A

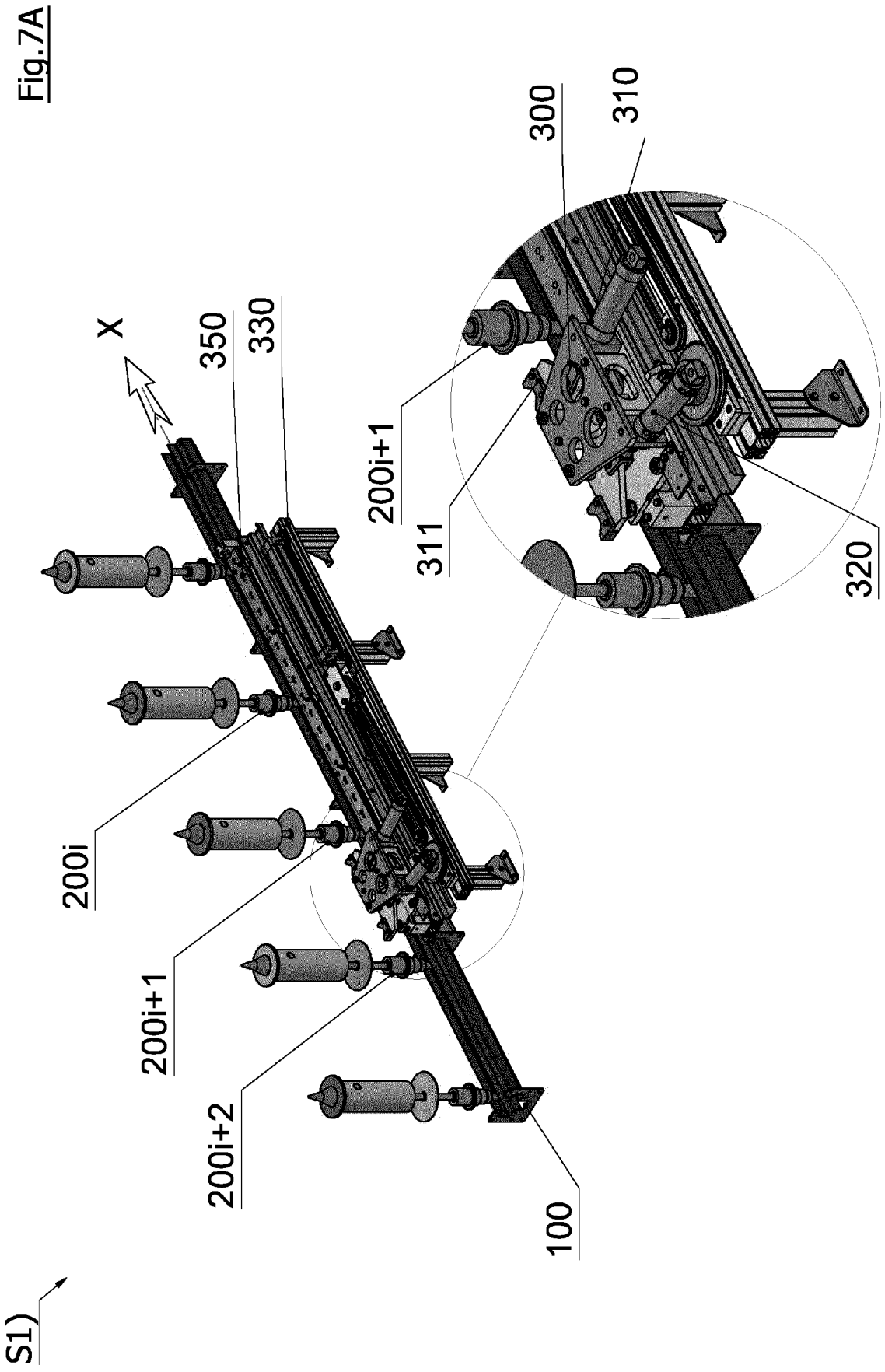


Fig.1B

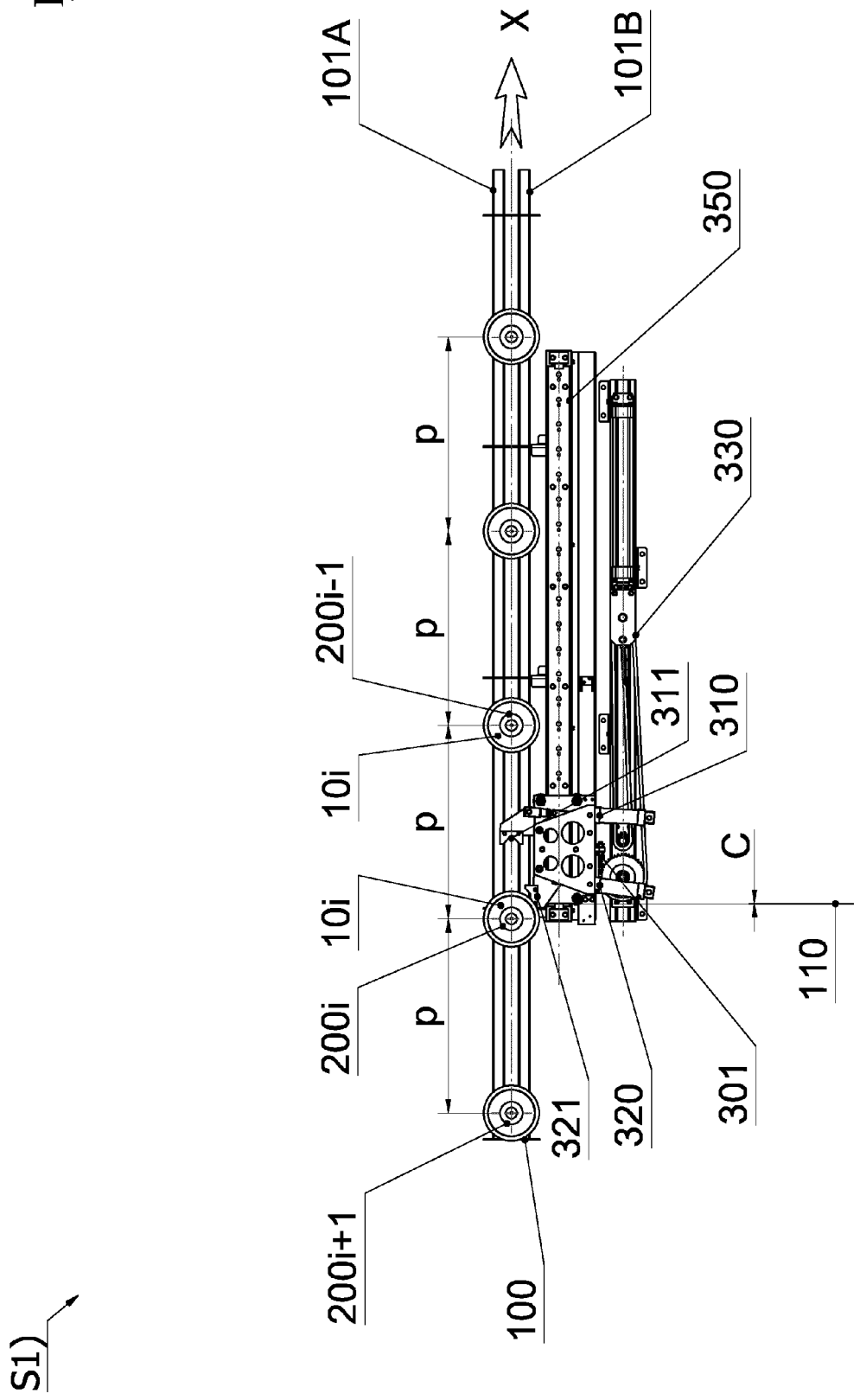

S1)
101A
X
101B
350
330
311
310
C
110
301
320
321
100
200i+1
200i
10i
10i
200i-1
p
p
p
p

Fig.2B

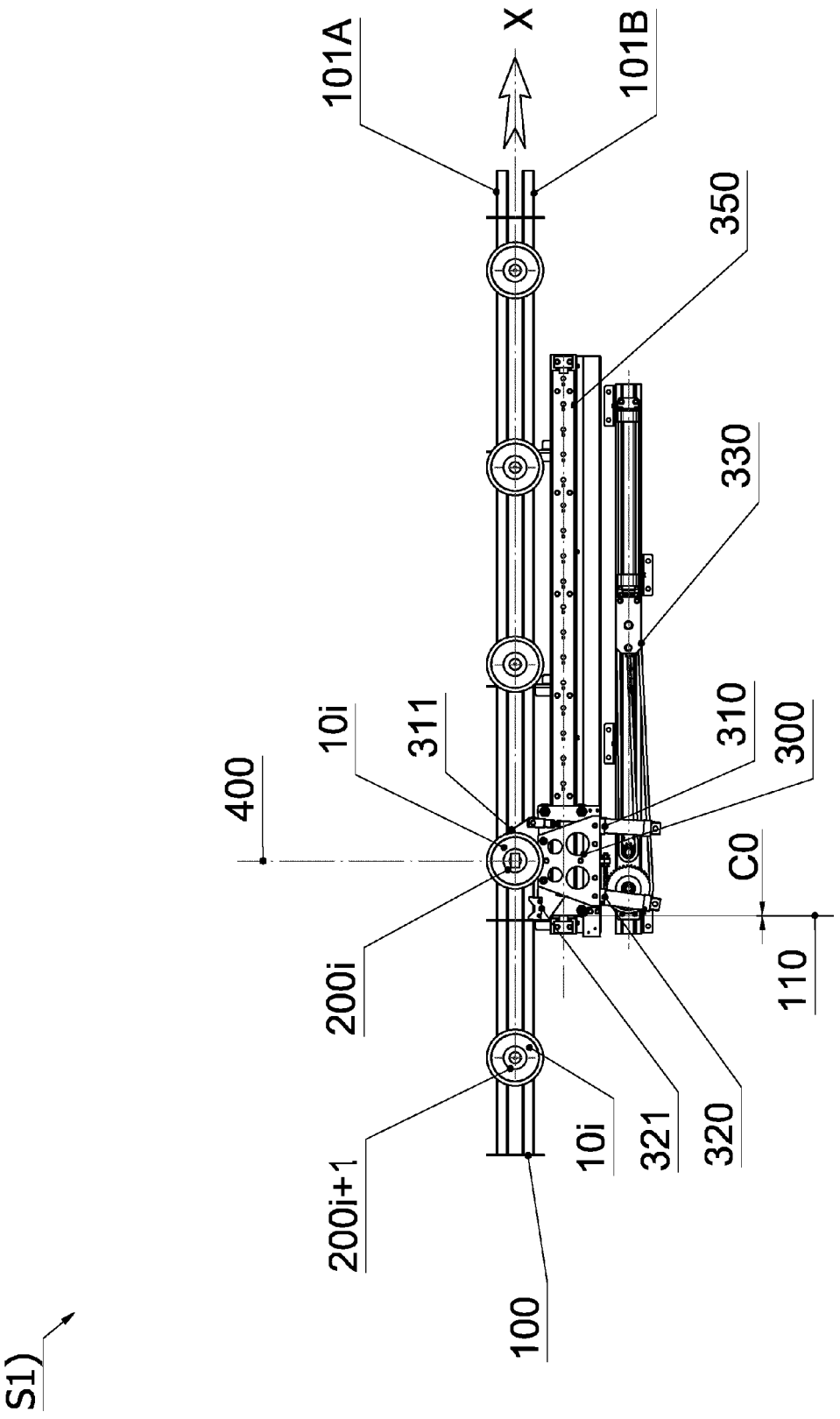

101A
X
101B
350
330
310
300
311
10i
400
C0
110
200i
200i+1
100
10i
321
320
S1)

Fig.3B

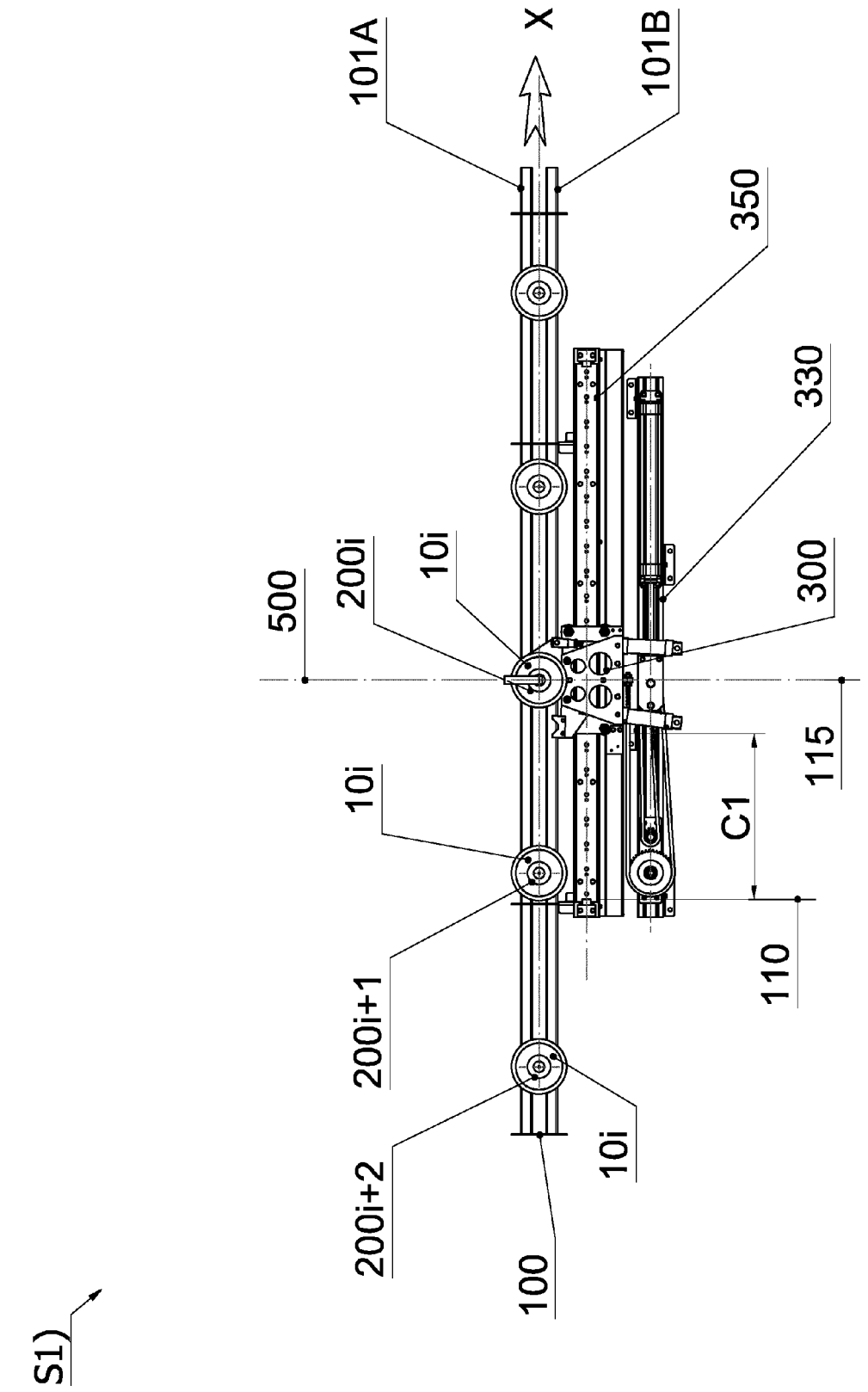
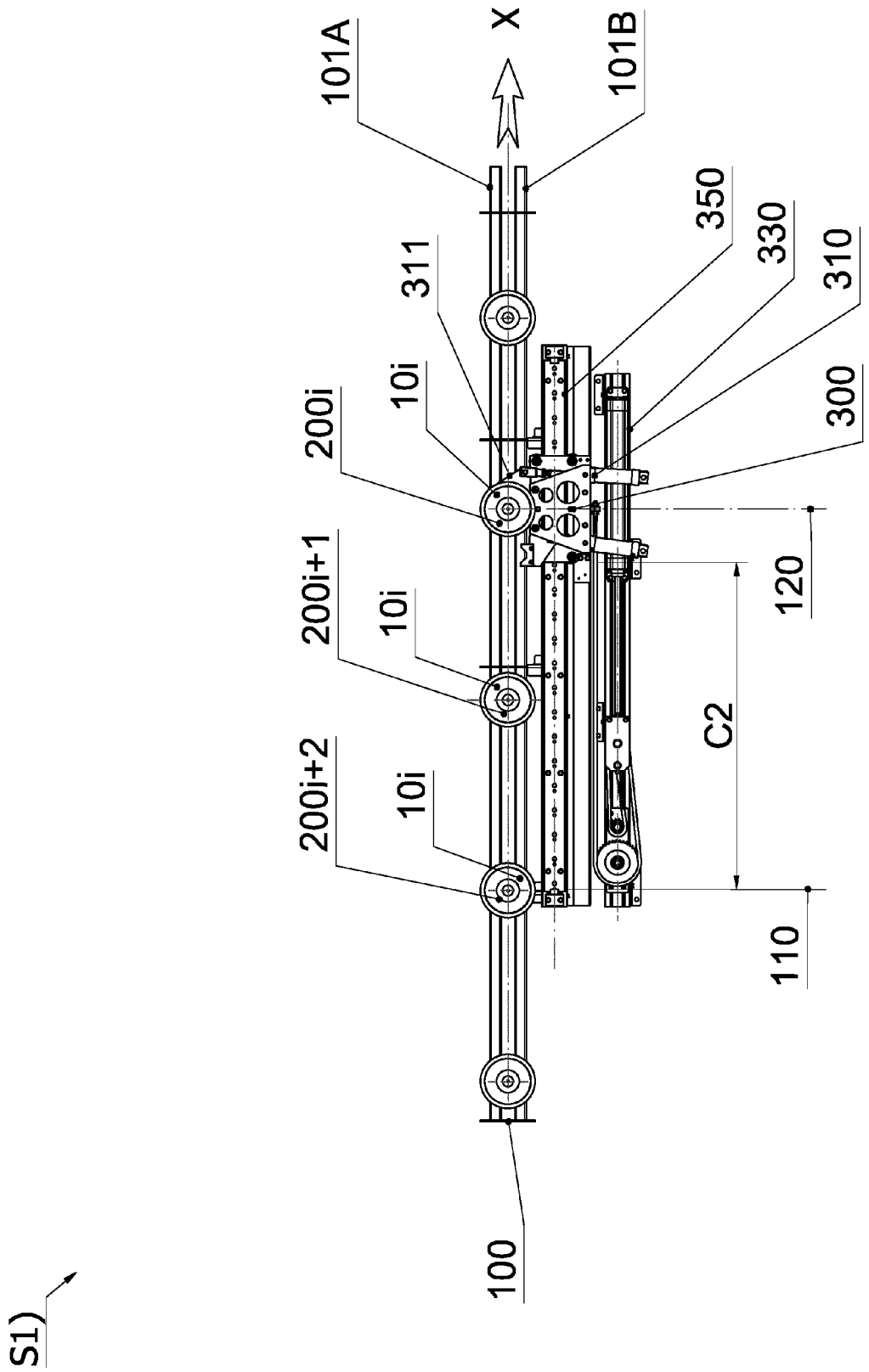

S1)
101A
X
101B
350
330
300
500
200i
10i
10i
200i+1
200i+2
100
10i
C1
115
110

Fig.4B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101B
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330
310
311
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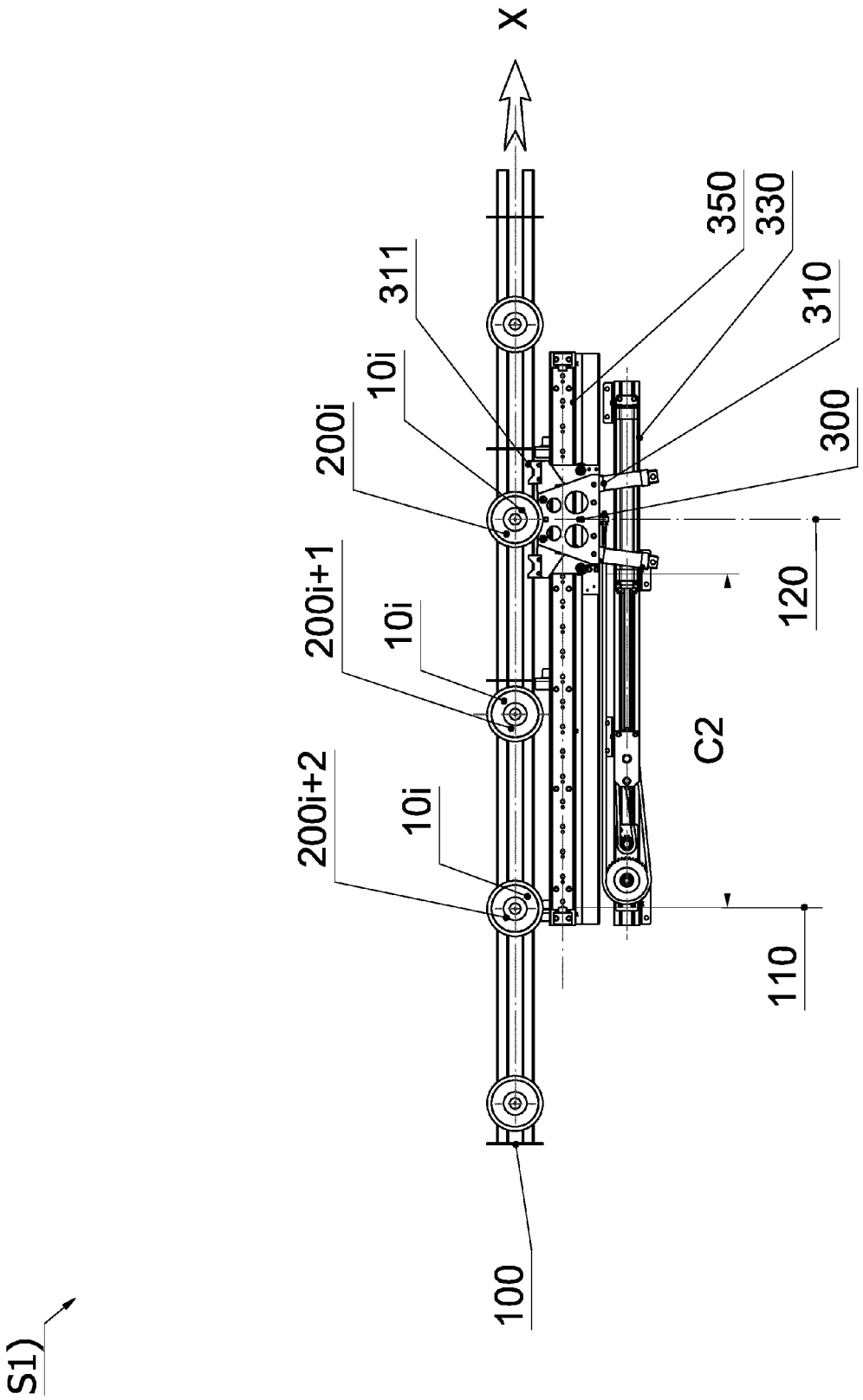
200i
300
200i+1
10i
120
C2
200i+2
10i
110
100
S1)

Fig.5B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C2
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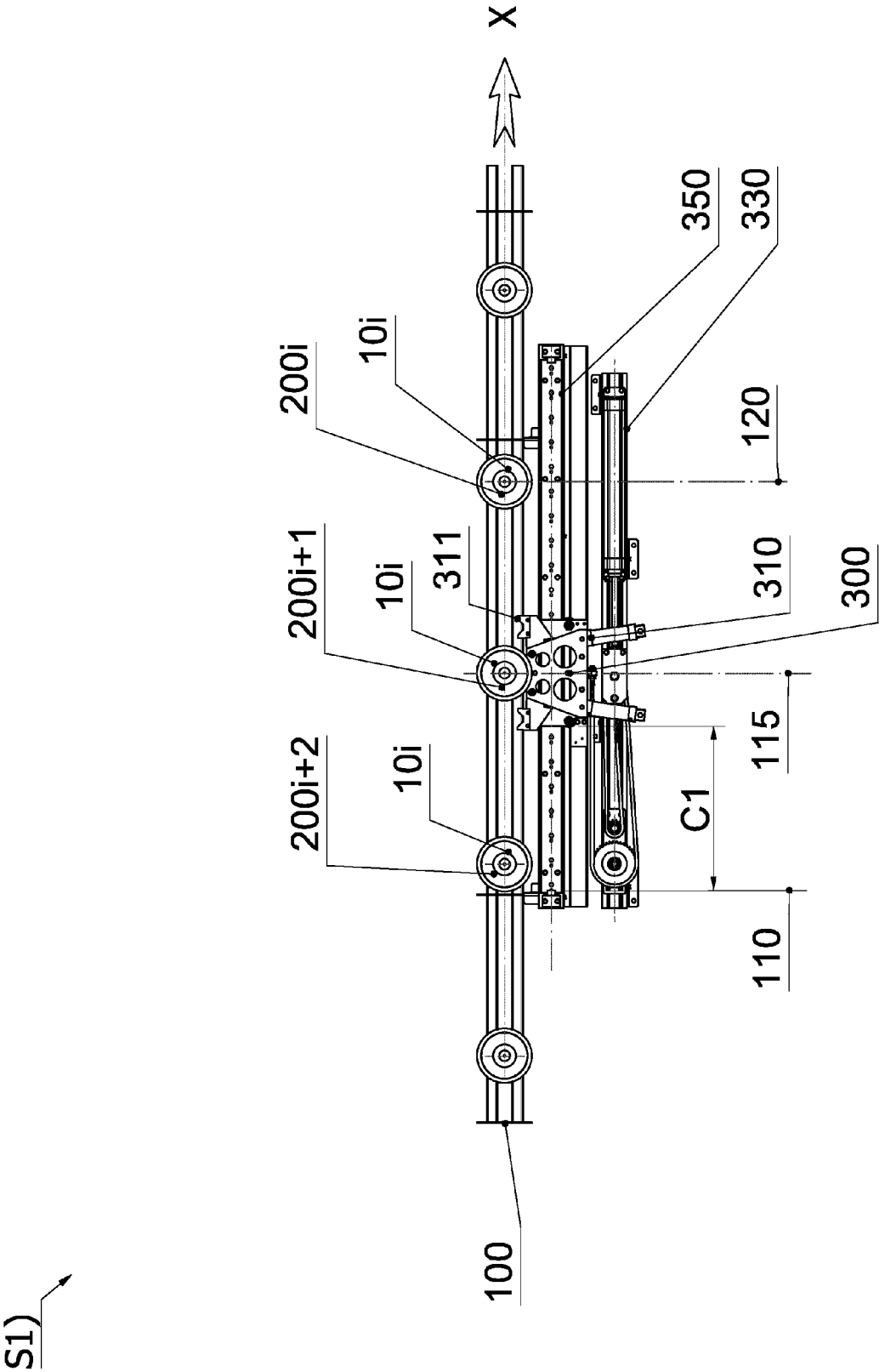
110
100
S1)

Fig.6B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10i
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10i
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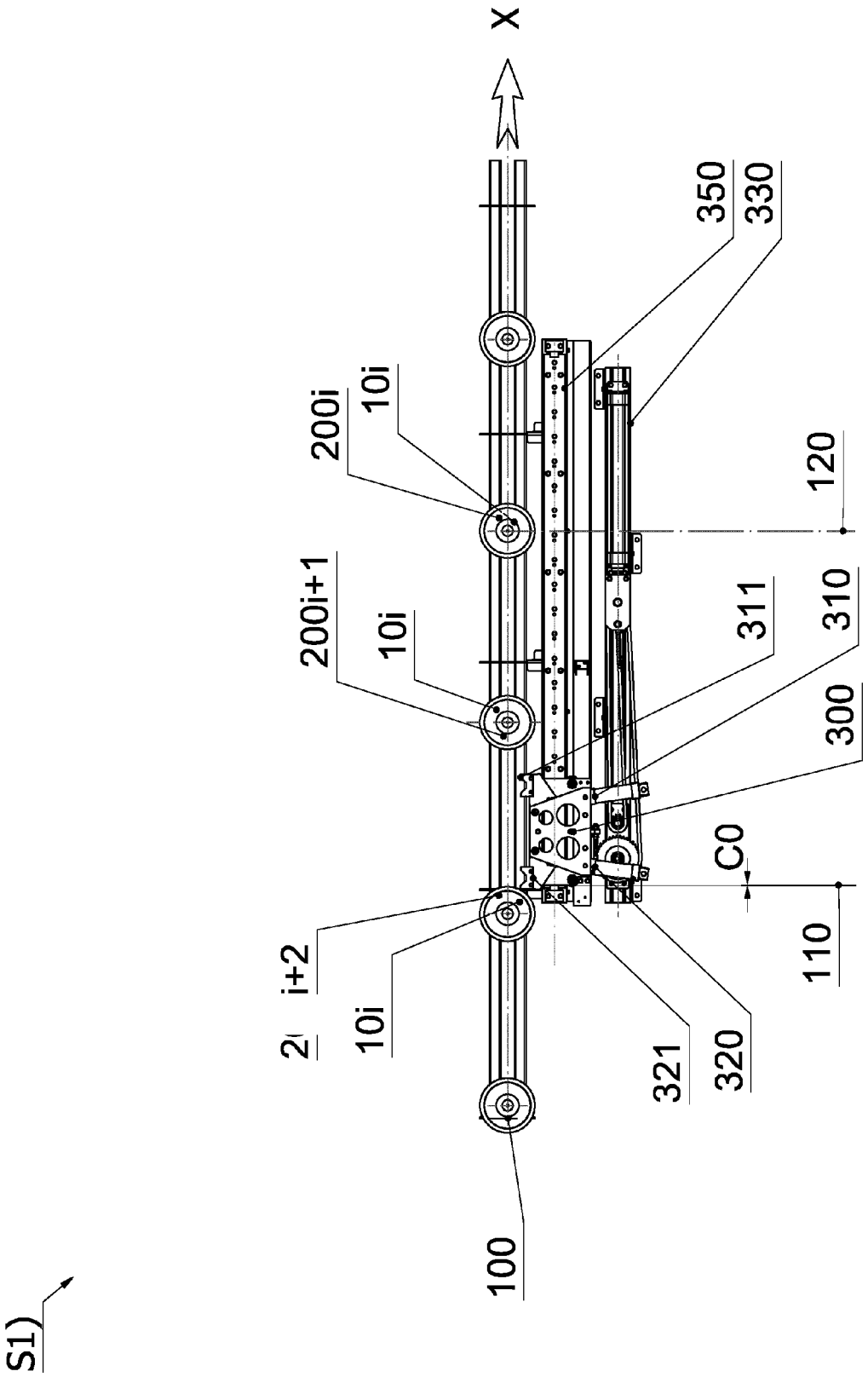
C1
110
100
S1)

Fig.7B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10i
321
320
100
S1)

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EUROPEAN SEARCH REPORT

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Place of search	Date of completion of the search	Examiner
The Hague	1 August 2022	Pedersen, Henrik

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